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U.S. Hydropower Resource Assessment for Colorado

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ABSTRACT

The U.S. Department of Energy is developing an estimate of the hydropower development potential in this country. Hydropower Evaluation Software (HES) is a computer model that was developed by the Idaho National Engineering Laboratory for this purpose. HES measures the potential hydropower resources available in the United States, using uniform criteria for measurement. The software was developed and tested using hydropower information and data provided by the Southwestern Power Administration. It is a dBASE, menu-driven software application. HES allows the personal computer user to assign environmental attributes to potential hydropower sites, calculate development suitability factors for each site based on the environmental attributes present, and generate reports based on these suitability factors. This report details the resource assessment results for the State of Colorado.

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INTRODUCTION

In June 1989, the U.S. Department of Energy (DOE) initiated the development of a National Energy Strategy to identify the energy resources available to support the expanding demand for energy in the United States. Public hearings conducted as part of the strategy development process indicated that potential hydropower resources were not well defined. As a result, the DOE established an interagency Hydropower Resource Assessment Team to ascertain the hydropower potential. In connection with these efforts by the DOE, the Idaho National Engineering Laboratory designed the Hydropower Evaluation Software (HES), which has been used to perform a resource assessment of the undeveloped hydropower potential in Colorado (as well as several other states). This report presents the results of the hydropower resource assessment for the State of Colorado. Pumped storage hydropower potential is not included.

The HES was developed as a tool to measure hydropower potential by regional power marketing administrations and state energy agencies, because they were the most likely to have and need accurate hydropower information. The HES was not intended to provide precise development factors for individual sites but to provide regional or state capacity totals. Because the software was developed as a generic measurement tool encompassing national issues, regional and state totals must be considered judiciously; various local issues may skew hydropower potential totals. The information for the resource assessment was compiled from the Federal Energy Regulatory Commission's Hydroelectric Power Resources Assessment database and several other sources. Refer to the *Hydropower Evaluation Software User's Manual* (Francfort, Matthews, Rinehart, 1991) for the specifics of the software and to the *Uniform Criteria for U.S. Hydropower Resource Assessment, Hydropower Evaluation Software Status Report* (Francfort, Moore, Rinehart, 1993) for an overview of all resource assessment activities to date.

Model Development

HES, both a probability-factor computer model and a database, is a dBASE, menu-driven software application that is intended to be user-friendly. Computer screens and report generation capabilities were developed to meet the needs of users nationwide. The software uses environmental attribute data to generate an overall project environmental suitability factor (PESF) between 0.1 and 0.9, where 0.9 indicates the highest likelihood of development, and 0.1 indicates the lowest likelihood of development. Suitability factors depend on environmental attributes of a potential site. These factors consider that (a) environmental concerns can make a potential site unacceptable, prohibiting its development (for a suitability factor of 0.1), or (b) absence of environmental concern can have little or no effect on the likelihood of site development (for a suitability factor of 0.9). A combination of attributes results in a lower suitability factor because multiple environmental considerations reduce the likelihood that a site may be developed to its physical potential.

Model Goal

The goal of the HES is to assemble an accurate resource database of all potential hydropower sites in the United States for use as a planning tool to determine the viable national hydropower potential. Potential hydropower is not limited to the development of new sites; it also includes the development of additional hydropower at sites that currently have hydropower but are not developed to their full potential. This hydropower potential is a source of nonpolluting, renewable energy available to meet the growing power needs of the United States. The HES should help make this goal obtainable and ensure a set of uniform criteria for national assessment.

Dam Status

The effects of environmental attributes vary by dam status. The dam status classifications follow the Federal Energy Regulatory Commission standard, which is

W = Developed hydropower site with power. The total hydropower capacity has not been fully developed. Only the undeveloped capacity is discussed in this report.

W/O = Developed site without power generation. The site has some type of developed impoundment or diversion structure but no hydropower generating capacity.

U = Undeveloped site. The site does not have power generation capability nor a developed impoundment or diversion structure.

ASSESSMENT RESULTS

Summary Results

A total of 251 sites have been identified and assessed for their hydropower potential. The HES results for site capacities range from 0.5 kilowatts to 125 megawatts. Most of the sites have potential capacities of under 5 megawatts (Figure 1).

The unadjusted hydropower potential for Colorado was identified as 2,346 megawatts. The HES results lower this estimate almost 72% to 665 megawatts. The greatest reduction in undeveloped potential occurs at sites with no physical structures present. These undeveloped sites have an HES-estimated capacity of 209 megawatts, a 85% reduction in capacity (Figure 2). The number of sites does not change; only the identified capacity is reassessed (Figure 3).

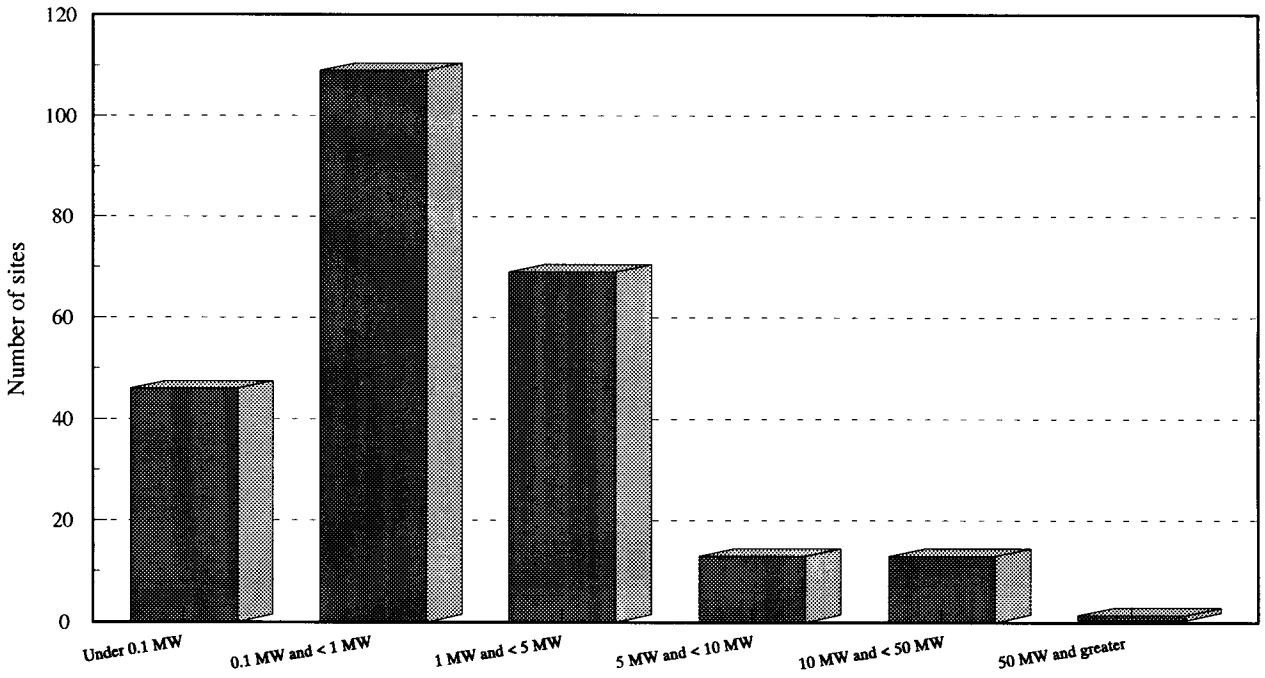

Figure 1. Number of sites with various HES-modeled capacity potentials.

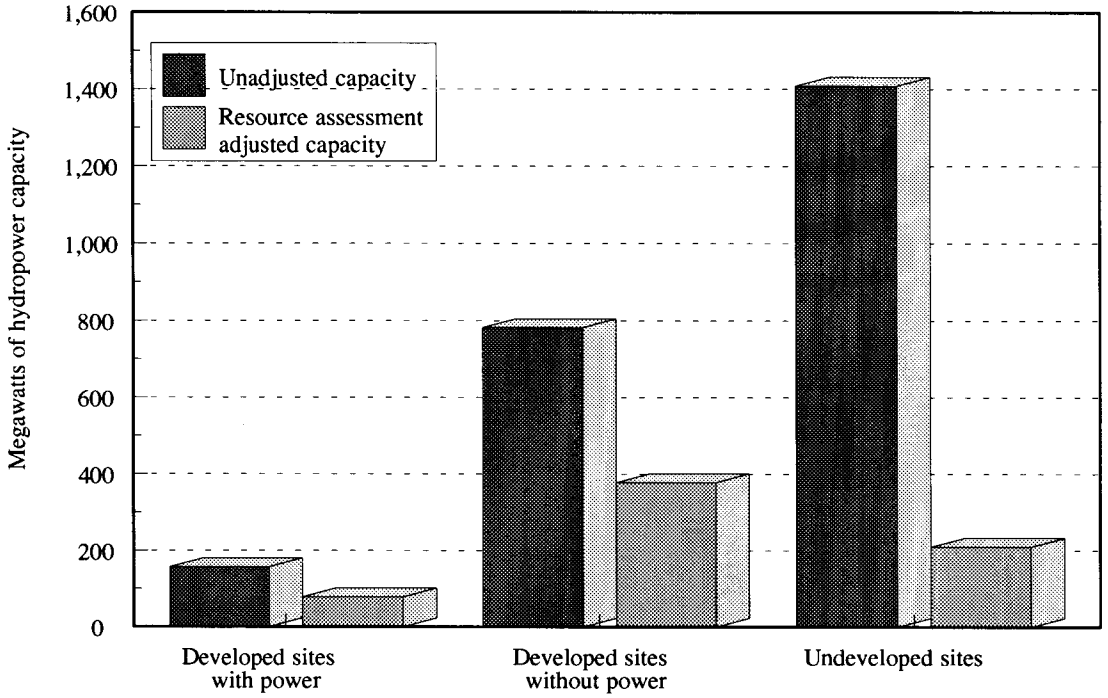

Figure 2. HES-identified hydropower potential and unadjusted potential.

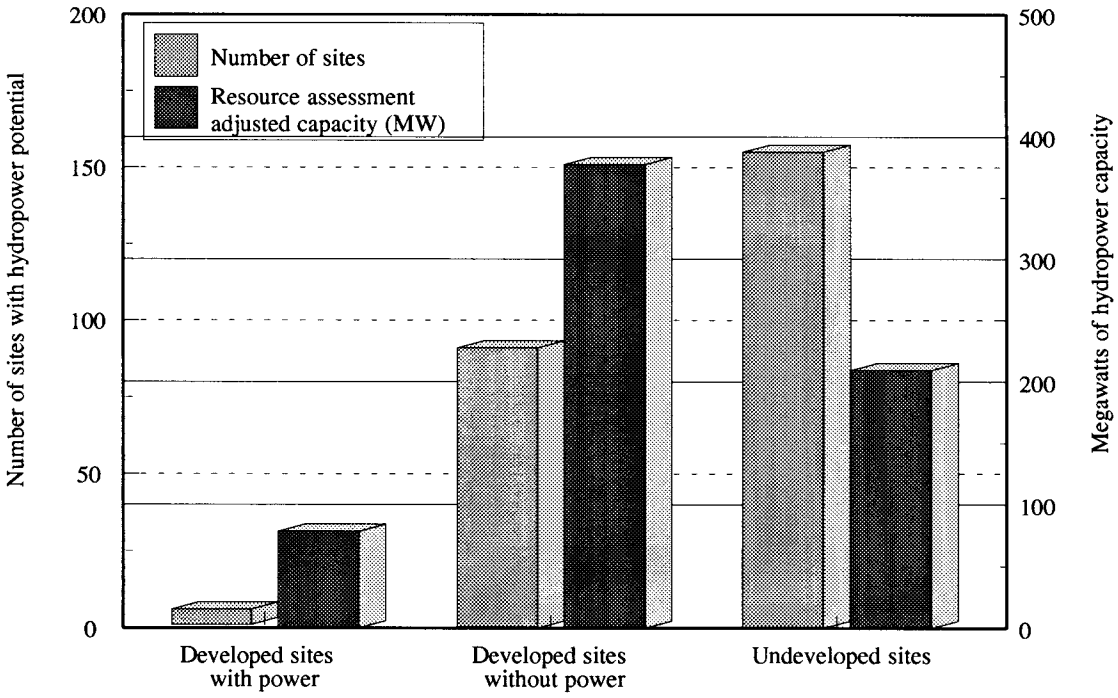

Figure 3. Number of sites with potential hydropower capacity and total megawatts of HES-modeled potential capacity.

The 251 identified sites are located within 11 major and several minor river basins. The number of sites per river basin ranges from three in the Colorado River Basin to 74 sites in the Platte River Basin (Figure 4). The Platte River Basin also has the most undeveloped hydropower potential of the Colorado river basins (Figure 5).

Detailed Results

The appendices contain, in the form of HES-generated reports, detailed information of the hydropower potential in Colorado. The appendices contain the following information:

Appendix A — The hydropower capacity summary printout groups sites by dam status. The number of sites, unadjusted capacity, and HES-adjusted capacity is provided based on the dam status.

Appendix B — The hydropower resource assessment by river basin includes the project number, project name, stream name, dam status, unadjusted capacity, and HES-adjusted capacity for each of the individual sites. Subtotals are provided for each river basin.

Appendix C — This is a listing of the project numbers, plant name, stream name, if a site is Federally owned, unadjusted capacity, and HES-adjusted capacity. The sites are grouped by dam status.

Appendix D — This section contains a resource database listing for each of the 251 sites in Colorado. Information includes plant, stream, state, county, river basin and owner names; project number; name plate and HES-adjusted capacity ratings; unit and plant types, dam status; latitude and longitude; and environmental factors that the HES uses to determine the project's environmental suitability factor.

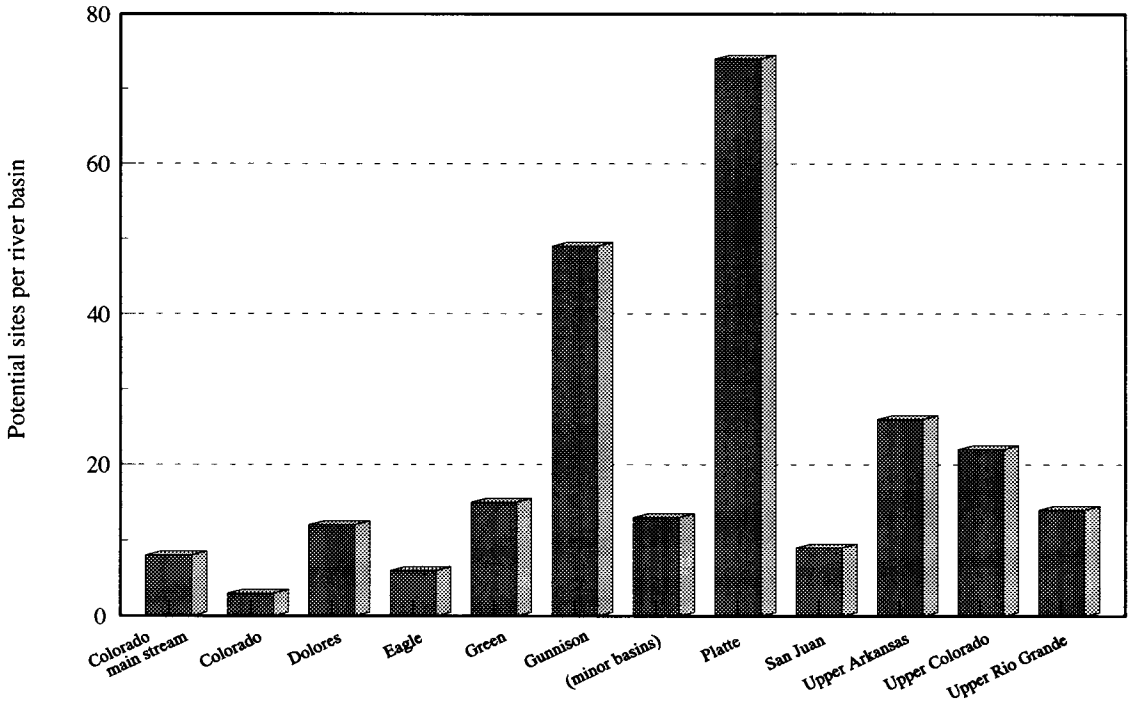

Figure 4. Number of sites with hydropower potential in the Colorado river basins.

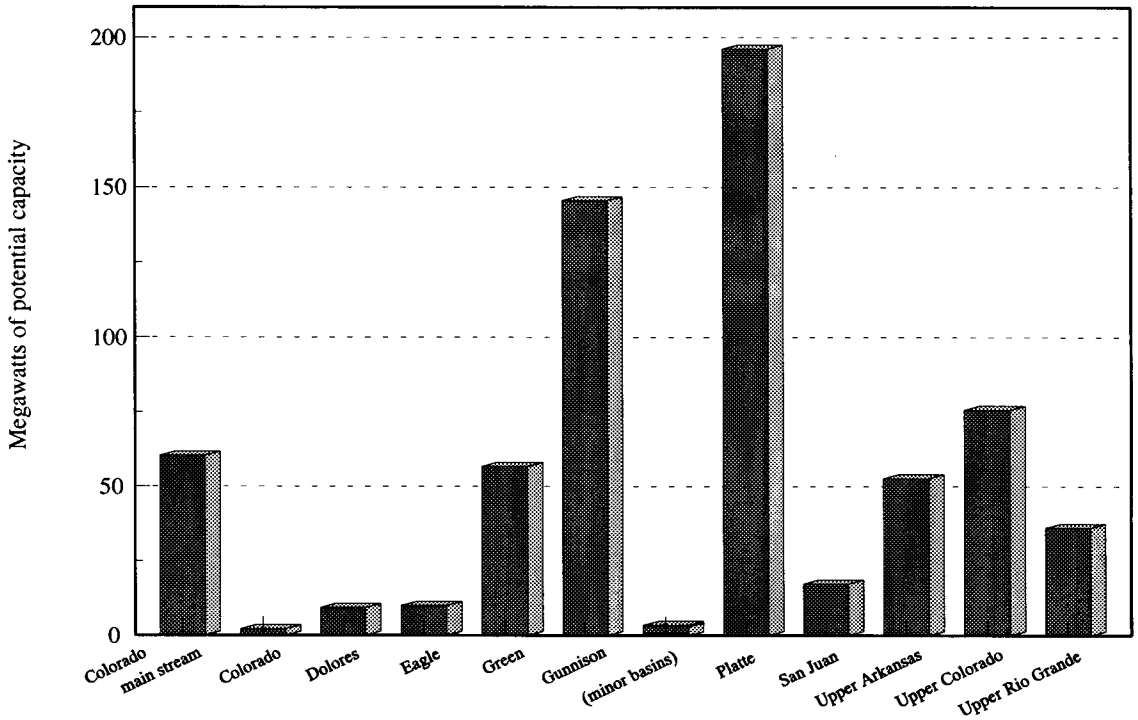

Figure 5. Megawatts of HES-modeled potential hydropower capacity in the Colorado river basins.

OBTAINING INDIVIDUAL STATE INFORMATION

Additional copies of the hydropower resource assessment results for individual states are available and can be obtained by writing or calling the National Technical Information Service (NTIS).

Telephone Orders—(703) 487-4650. NTIS sales desk and customer services are available between 8:30 a.m. and 5:00 p.m., Eastern Standard Time.

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For Help in Tracing an Order—(703) 487-4650. Request the customer service option.

ADDITIONAL HYDROPOWER EVALUATION SOFTWARE INFORMATION

Additional information concerning the HES can be obtained by contacting Ben Rinehart or Jim Francfort at the addresses provided. Copies of the software and *Hydropower Evaluation Software User's Manual* may also be obtained from these individuals.

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Information concerning the State of Colorado's involvement with the resource assessment or about the identified sites may be obtained by contacting:

Will Burt
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Department of Natural Resources
818 Centennial Building
1313 Sherman Street
Denver, CO 80203
(303) 866-3639

REFERENCES

Francfort, J. E., S. D. Matthews, and B. N. Rinehart, 1991, *Hydropower Evaluation Software User's Manual*, DOE/ID-10338, Idaho National Engineering Laboratory, Idaho Falls, Idaho.

Francfort, J. E., K. M. Moore, and B. N. Rinehart, 1993, *Uniform Criteria for U.S. Hydropower Resource Assessment, Hydropower Evaluation Software Status Report*, DOE/ID-10430, Idaho National Engineering Laboratory, Idaho Falls, Idaho.